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ORIGINAL ARTICLE

Psychological and sports-based rehabilitation of combatants through adaptive strength sports

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ABSTRACT

Aim: To investigate the impact of strength sports (using kettlebell lifting as an example) on the effectiveness of psychological and sports-based rehabilitation for combatants.

Materials and Methods: The research, conducted in 2025-2026, included 63 combat veterans who had undergone limb amputations and sustained various traumatic injuries resulting from shrapnel and gunshot wounds. The participants were divided into three groups based on the type of injuries sustained. The dynamics of the combat veterans' psychological state were assessed using the "Assessment of Neuro-Emotional Stress" method; somatic health was assessed using the self-assessment of health status method proposed by V. P. Voitenko. The research was conducted using Google Forms.

Results: The research results showed a statistically significant decrease in neuro-emotional stress across all groups ($p \leq 0.01$), as well as a reduction in the number of individuals with high levels of psycho-emotional workload. A reduction in intergroup differences was observed, indicating an improvement in the psycho-emotional state of combat veterans. Assessment of somatic health confirmed a significant improvement in indicators across all groups ($p \leq 0.001$). A positive effect of kettlebell exercises on the effectiveness of psychological and sports-based rehabilitation for combat veterans was established, attributable to the combined action of physiological, psychological, and socio-adaptive factors.

Conclusions: The results obtained provide grounds for considering kettlebell exercises as an effective means of psychological and sports-based rehabilitation for combat veterans, as well as for their social reintegration, and it is advisable to incorporate them into adaptive sports and veteran sports programs.

KEY WORDS: health, strength sports, kettlebell exercises, neuro-emotional stress, psychological rehabilitation, sports-based rehabilitation, combatants, combat veterans.

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INTRODUCTION

In the current context of the military conflict between Ukraine and russia, the number of combat veterans who have suffered injuries and limb amputations as a result of blast and shrapnel wounds is on the rise. Under these circumstances, the issue of their comprehensive rehabilitation – which involves restoring both physical and mental health – takes on particular significance [1, 2]. This is due to the multifaceted nature of combat injuries, which are accompanied not only by somatic impairments but also by significant psycho-emotional disorders that substantially complicate the process of social adaptation [3, 4].

Under such conditions, the consequences of combat experience – including injuries, prolonged exposure to stressors, post-traumatic disorders, and reduced physical fitness – objectively highlight the need for the implementation of effective rehabilitation technologies [5, 6]. Modern approaches to the rehabilitation of wounded military personnel are primarily focused on integrating physical education and sports as a means of restoring the body's functional capabilities and normalizing the psycho-emotional state [7, 8]. The use of strength sports, which combine the development of strength, endurance, and coordination of movement while fostering willpower, self-regulation, and stress resilience, is

promising [9, 10]. In the system of physical rehabilitation for military personnel, the implementation of strength and function-oriented training methods is becoming increasingly significant, aimed not only at restoring the body's functional state but also at enhancing its overall adaptive capacity. In light of this, particular attention should be paid to various types of functional training, specifically programs such as "CrossFit," which combine strength, aerobic, and coordination workloads, provide a comprehensive effect on the body, and contribute to the restoration of work capacity, the development of endurance, and the formation of psychological resilience [11, 12].

Strength-based forms of physical activity are increasingly being integrated into rehabilitation programs for combat veterans, as they contribute not only to the restoration of lost functions but also to the development of a sense of control over one's own body, increased self-esteem, and motivation for further recovery and improvement [13, 14]. The variability of loads and the possibility of applying an individualized approach to exercise execution ensure that such methods are accessible to individuals with varying levels of functional limitation. Against this backdrop, the use of kettlebell exercises as an effective and accessible means of strength training becomes particularly relevant [15]. They have become widely used in both training and competitive practice in adaptive and veteran sports. In particular, such exercises are actively incorporated into competition programs organized by institutions such as the Kettlebell Lifting Union and the Strongman Federation, which attests to their significant potential in the system of physical rehabilitation and social adaptation for military personnel. Kettlebell modalities are widely used during strength and functional training for participants in the Invictus Games (Invictus Games Foundation) [16]. Within this framework, kettlebell exercises are adapted to accommodate individuals with various functional limitations, including combat veterans with amputations and other disabilities. This practice demonstrates the versatility and adaptability of kettlebell training as a tool for physical rehabilitation, allowing for the customization of exercise intensity according to an individual's functional capabilities [17].

Despite the existence of a significant number of studies in the field of combat veterans' rehabilitation [1, 2, 18], the issue of the comprehensive impact of kettlebell sport on the psychological state and physical health of individuals with various types of combat injuries (amputations, shrapnel wounds) remains under-researched. Scientific justification for the effectiveness of such modalities, using both objective and subjective assessment methods, is becoming increasingly relevant. At the same time, the differential impact of kettlebell training on individuals with different types of combat injuries remains insufficiently studied.

The analysis of scientific sources indicates that the issue of rehabilitation for combat veterans is addressed within the framework of medical, psychological, and physical education and health research [9, 19, 20]. Researchers emphasize the need for a comprehensive approach that combines physical activity with psychological support and social adaptation for these individuals [21]. Research in the field of physical rehabilitation provides grounds for concluding that systematic physical activity improves the functional state of the cardiovascular and respiratory systems, increases work capacity, and restores motor functions [22]. At the same time, psychological studies have demonstrated the positive impact of physical exercise on reducing anxiety levels, depressive symptoms, and symptoms of post-traumatic stress disorder [5]. Researchers highlight the significance of strength sports in developing willpower, self-control, and confidence in one's abilities [13]. In addition, kettlebell lifting is an effective means of developing strength endurance, coordination, and functional fitness [15, 16].

The analysis of competition programs and regulations for kettlebell exercises demonstrates their adaptive nature and the potential for varied applications depending on participants' functional status. In particular, individuals with lower-limb impairments (amputations, severe injuries, impaired leg function) perform kettlebell exercises primarily in a seated position (kettlebell press). Still, they can also be performed in a standing position (press, long-cycle clean and jerk, kettlebell snatch). Competitors with upper limb impairments (amputation of one arm or significant functional limitations), or the consequences of injuries without amputation (soft tissue injuries, effects of concussions, traumatic brain injuries, etc.) may perform exercises in both positions [21].

Kettlebell exercises are also used for functional rehabilitation in individuals with neurological disorders [19]. However, their application requires an individualized approach, gradual progression of the workload, and mandatory medical and pedagogical supervision. With appropriate adaptation, such exercises contribute to the development of muscle strength and endurance, improved intermuscular coordination, stimulation of compensatory motor mechanisms, and increased overall functional fitness [23]. These findings demonstrate the significant potential of kettlebell lifting as a universal means of physical training and adaptation for individuals with various types of impairments. At the same time, its potential within the rehabilitation

system for combat veterans remains insufficiently studied, particularly in terms of its impact on psychological characteristics. This creates a scientific need for comprehensive research to study the impact of kettlebell lifting on the physical and psycho-emotional states of combat veterans, using valid diagnostic methods.

AIM

The aim is to investigate the impact of strength sports (using kettlebell lifting as an example) on the effectiveness of psychological and sports-based rehabilitation for combatants.

MATERIALS AND METHODS

PARTICIPANTS

The research was conducted between 2025 and 2026 with the participation of 63 combat veterans (men) who had limb amputations (n = 37) or various traumatic injuries resulting from shrapnel and gunshot wounds (n = 26). To systematize the results, they were divided into 3 groups. To standardize the research, a proprietary group coding system was used, developed in accordance with the approaches of the International Classification of Functioning, Disability, and Health. Group 1 (LL-A) included individuals with lower limb amputations (n = 19): LL-A1 – amputation of one lower limb (n = 12), LL-A2 – amputation of both lower limbs (n = 7). Group 2 (n = 18) comprised individuals with significant functional impairment or amputation of an upper limb (UL-A1). Group 3 (NA) consisted of individuals without amputations (n = 26), among whom the following subgroups were identified: NA-NEU (individuals with neurological sequelae of injuries (n = 15)) and NA-MSK (participants with musculoskeletal injuries (n = 11)).

The testing involved participants who, during 2025-2026, competed for the first time in Ukrainian kettlebell lifting championships and cups, as well as in events organized by the Ukrainian Strongman Federation, whose programs included kettlebell strength exercises. Retesting was conducted after the completion of a one-year cycle of systematic training, competition participation, and sports rehabilitation activities.

The inclusion criteria were defined as follows: male gender; participants' membership in one of the study groups based on the type of injury; participation in competitions and events involving kettlebell exercises (at least 3 times a year); and the participants' voluntary consent to take part in the research (each participant provided written consent). Exclusion criteria were the participant's personal desire to withdraw from the research at any time or a deterioration in health that prevented the participant from continuing training and competing. Research limitations: participants' age, duration of combat service, military and athletic rank, prior experience in training and competition in any sport, marital status, education, and financial status were not considered. We also did not monitor the number of competitions and other sports- and health-related events in which the participant took part during the year, nor the methodology of the training process (number, duration, and focus of sessions, and the presence of a coach/rehabilitation specialist).

The results were processed at the Department of Physical Education and Sports Rehabilitation of S. P. Koroliov Zhytomyr Military Institute (Zhytomyr, Ukraine) and the Department of Special Physical Training of the National Academy of Internal Affairs (Kyiv, Ukraine).

METHODS

The research used a combination of theoretical and empirical methods, as well as mathematical statistics. Analysis and generalization of literary sources were used to conduct an analytical review of scientific sources on the outlined range of issues (28 sources from PubMed, Scopus, Web of Science, and Index Copernicus were analyzed).

To assess the dynamics of the psychological state of combat veterans, we applied the "Assessment of Neuro-Emotional Stress" method (proposed by T. A. Nemchyn), which enables the precise determination of the level of psycho-emotional workload among the subjects. Indicators of this method should be interpreted as markers of functional mental state and neuropsychological tension that indirectly reflect participants' adaptive capabilities. The method includes 30 state characteristics, categorized into three levels of manifestation: A – low, B – average, C – high. By selecting one of the response options, the respondents assessed their own level of neuropsychological tension during the research period. The results were processed by summing the points: response "A" was assigned 1 point, "B" – 2 points, and "C" – 3 points. The interpretation of the total indicators was based on the following ranges: 30-50 points – low level of neuropsychological tension; 51-70 points – average level; 71-90 points – high level [24].

To determine the dynamics of combat veterans' health indicators, V. P. Voitenko's self-assessment method for somatic health was used. The test contains 29 questions: the first 28 are answered with "yes" or "no," while the last one is rated on a scale of "good," "satisfactory," "poor," and "very poor." The first 28 questions were scored using a point system: for each "yes" answer, the respondent re-

Table 1. Dynamics in psychological and somatic health indicators among combat veterans (n = 63) during kettlebell training sessions, X ± m, points

Studied groups	Stages of the research		Significance of the difference	
	Initial	Final	t	p
Indicators of neuro-emotional stress (according to T. A. Nemchyn's method)				
Group 1 (n=19) (LL-A1, n=12; LL-A2; n=7)	72.85±1.77	63.66±1.86	3.579	≤0.01
Group 2 (UL-A1; n=18)	69.74±1.87	61.39±1.90	3.132	≤0.01
Group 3, (n=26) (NA-NEU, n=15; NA-MSK, n=11)	67.42±1.81	58.39±1.85	3.489	≤0.01
Indicators of somatic health (according to V. P. Voitenko's method)				
Group 1 (n=19) (LL-A1, n=12; LL-A2; n=7)	21.16±0.87	12.23±0.69	7.863	≤0.001
Group 2 (UL-A1; n=18)	18.74±0.81	10.42±0.83	7.174	≤0.001
Group 3, (n=26) (NA-NEU, n=15; NA-MSK, n=11)	17.93±0.78	6.57±0.84	9.910	≤0.001

Legend: X – arithmetic mean, m – error of arithmetic mean, t – value of Student's t-test, p – level of statistical significance of differences
Source: compiled by the authors of this study

ceived 1 point; for a "no" answer, 0 points. An additional 1 point was awarded if the respondent selected "poor" or "very poor" for the final question. The final indicator reflected a quantitative self-assessment of health status. The results were interpreted according to the following criteria: 0-3 points – excellent health; 4-7 points – good; 8-13 points – fair; 14-20 points – satisfactory; 21-29 points – poor health [25]. The survey was conducted using the specified methods via an electronic form (Google Forms).

STATISTICAL METHODS

The methods of mathematical statistics were used to process the data obtained. The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as X ± m, where X is the arithmetic mean, m is the standard error. The reliability of the difference was set at $p<0.05$. All statistical analyses were performed using STATISTICA 6.1 software package (number AGAR909E415822FA), adapted for medical and biological research.

ETHICS

The procedure for organizing the study and the topic of the article were previously agreed with the Committee on compliance with Academic Integrity and Ethics of the National Academy of Internal Affairs. Also this study followed the regulations of the World Medical Association Declaration of Helsinki. Informed consent was received from all participants who took part in this study.

AI STATEMENT

The author states that no AI tools were used in writing this article.

FRAMEWORK

This scientific article was carried out according to the plan of the research work of the National Academy of Internal Affairs for 2020-2026 "Psychological, pedagogical and sociological support of law enforcement officers» (state registration number 0113U008196).

RESULTS

The research results showed that regular kettlebell training sessions, combined with competitive activities, led to a statistically significant improvement in the psychophysical status of combat veterans across all study groups. A statistically significant decrease in neuropsychological tension ($p \leq 0.01$) and an improvement in self-assessment indicators of somatic health ($p \leq 0.001$) were observed. At the same time, a reduction in the number of individuals with high levels of neuro-emotional stress and in those with poor or satisfactory health status, and a decrease in intergroup differences in the studied indicators were observed (Table 1). The obtained data should be considered evidence of the optimization of the subjects' current mental state, which may be due to the systematic influence of dosed physical exercise, an increase in functional fitness, and involvement in competitive activities, which have significant motivational and social-adaptive potential.

At the initial stage of the research, the neuropsychological tension indicator for participants in Group 1 (LL-A1/LL-A2) was 72.85 ± 1.77 points, indicating a high level and significant psycho-emotional workload. After completing a year-long training cycle and systematic participation in competitions involving kettlebell strength exercises, the indicator decreased significantly by 9.19 points to 63.66 ± 1.86 points ($p \leq 0.01$), revealing an average level of neuropsychological tension. At the same time, the number of individuals with a high level of tension decreased from 52.6 % to 21.1 %. The analysis of participants' self-assessments of somatic health also revealed a positive trend: the health status indicator decreased from 21.16 ± 0.87 points (poor level) to 12.23 ± 0.69 points ($p \leq 0.001$), indicating an average level of somatic health. The results indicate an improvement in the psycho-emotional state, a reduction in physical and psychological discomfort, and an increase in the body's adaptive capabilities, despite severe functional impairments.

In individuals in Group 2 (UL-A1), who had undergone amputation or had functional impairments of the upper limb, the neuropsychological tension indicator at the initial stage was 69.74 ± 1.87 points and was assessed as average. The results of the follow-up examination revealed a significant decrease in this indicator to 61.39 ± 1.90 points ($p \leq 0.01$). At the same time, the number of individuals with a high level of neuropsychological tension decreased from 44.4 % to 16.7 %. Positive dynamics were also observed using V. P. Voitenko's method: the self-assessment indicator for somatic health improved significantly from 18.74 ± 0.81 points (satisfactory level) to 10.42 ± 0.83 points ($p \leq 0.001$), indicating a transition to an average level of somatic health. The results obtained may be associated with improved functional capacity, increased physical fitness, and the development of more stable adaptive mechanisms.

The representatives of Group 3 (NA-NEU, NA-MSK), who had musculoskeletal system injuries and neurological consequences of injuries without amputations, also showed a significant improvement in the studied indicators. In particular, the level of neuropsychological tension decreased from 67.42 ± 1.81 points at the initial stage to 58.39 ± 1.85 points at the final stage ($p \leq 0.01$), and the number of individuals with high tension levels decreased from 34.6 % to 7.7 %, which is the most pronounced positive change among the study groups.

The average self-assessment of somatic health improved significantly from 17.93 ± 0.78 points (satisfactory) to 6.57 ± 0.84 points (good; $p \leq 0.001$). The results indicate the high effectiveness of systematic kettlebell exercises in optimizing the psycho-emotional state and improving subjective perception of health in individuals with preserved functional reserves.

The comparative analysis of the results showed that, at the initial stage, the least favorable indicators of psychophysical state were observed among individuals with lower-limb amputations. In contrast, the best results were observed in the group without amputations. After completing the one-year exercise cycle, all groups showed improvements, with indicators shifting toward more favorable levels of neuropsychological tension and somatic health. At the same time, intergroup differences decreased, suggesting a positive impact of systematic kettlebell training sessions, regardless of injury type.

DISCUSSION

The results of the studies confirm the effectiveness of the systematic use of kettlebell exercises as a means of psychological and sports-based rehabilitation for combat veterans with limb amputations, musculoskeletal disorders, and neurological sequelae of combat injuries [19]. The statistically significant reduction in neuro-emotional stress and improvements in somatic health indicators observed across all study groups demonstrate the positive impact of training and competitive activities on the psychophysiological state of combat veterans.

The combined effect of several factors can explain the results obtained. First, systematic physical exercise improved the functional state of the cardiovascular, respiratory, muscular, and nervous systems, and increased strength, endurance, and overall working capacity. Second, participation in the training and competition process positively affected the subjects' psychological and emotional state, reducing anxiety, building self-confidence, and increasing motivation for an active lifestyle. Third, the social adaptation component is of significant importance, as it involves integrating combat veterans into a sports environment, expanding social interaction, and restoring social activity. The combination of these factors led to positive changes in participants' subjective perceptions of their health and overall psychophysical status.

Particular attention is drawn to the fact that the most pronounced positive changes were observed in groups with more severe functional impairments, primarily among individuals with lower-limb amputations. Although the members of this group exhibited the worst baseline indicators in both neuropsychological tension levels and self-assessment of somatic health, a significant improvement in the studied parameters was observed after completing a one-year cycle of

kettlebell training. This may indicate the body's significant adaptive potential, even in the presence of severe structural and functional impairments, as well as the high efficiency of dosed strength loads during recovery.

At the same time, the group of individuals without amputations (NA-NEU, NA-MSK) showed the most pronounced positive trends in health indicators and the greatest reduction in the number of individuals with high levels of neuropsychological tension. This is likely due to greater preservation of the body's functional reserves, a greater capacity for physical exercise, and faster development of adaptive mechanisms. The results obtained are consistent with the current understanding, according to which the effectiveness of physical rehabilitation depends to a significant extent on the degree of functional limitations and the body's initial condition [5, 7, 22].

The combined effect of physiological, psychological, and social factors can explain the observed reduction in neuro-emotional stress. From a physiological perspective, systematic strength training helps optimize cardiovascular and nervous system function, increase endurance, improve neuromuscular coordination, and develop stable adaptive responses to stressors [15]. In addition, regular physical activity is associated with reduced levels of anxiety, emotional exhaustion, and mental stress, which is particularly important for individuals with combat experience.

Positive changes in psycho-emotional state may also be linked to the psychological benefits of sports participation. Participation in training and competitions contributed to increased self-esteem, greater confidence in one's physical abilities, restored motivation for an active lifestyle, and improved self-control [7, 23, 26]. For individuals who have suffered combat injuries and amputations, not only physical recovery but also the restoration of a sense of personal efficacy and social significance becomes crucial, which directly influences the overall perception of one's own health [3, 4, 27, 28].

The social adaptation component of the research likely played a significant role as well. Engaging combat veterans in a sports environment created conditions for expanding social contacts, mutual support, and integration into a community of individuals with similar experiences. This helped reduce social isolation, increase emotional resilience, and foster a positive psychological and emotional state. It is also important that participation in competitions provides an additional motivational incentive for regular training and self-improvement.

The results obtained provide grounds for asserting that kettlebell exercises should be viewed not only as a means of developing strength, but also as an effective tool for the psychological and sports-based rehabilitation of combat veterans. Their use contributes to improving the body's functional state, optimizing the psycho-emotional state, and increasing the subjective assessment of health status, regardless of the nature of the injuries sustained. At the same time, the research results should be interpreted with certain limitations in mind. In particular, the research included a relatively small sample of participants, and the assessment of health status was partly based on self-reports, which may introduce subjectivity into the data.

CONCLUSIONS

The systematic use of kettlebell strength exercises, combined with training and competitive activities, results in a statistically significant reduction in neuro-emotional stress among combat veterans, regardless of the nature of their injuries ($p \leq 0.01$). A reduction in the number of individuals with high levels of neuropsychological tension and an improvement in their psycho-emotional state were observed. Health assessment results confirmed a significant improvement in all study groups ($p \leq 0.001$). The positive effects of kettlebell exercises stem from the combined action of physiological, psychological, and socio-adaptive factors, including improved functional fitness, increased motivation, the development of self-confidence, and the integration of combat veterans into a sports environment.

The results provide grounds for considering kettlebell exercises as an effective means of psychological and sports-based rehabilitation for combat veterans, and for incorporating them into adaptive and veteran sports programs.

PROSPECTS FOR FURTHER RESEARCH

Promising areas for further research include studying the long-term effects of kettlebell exercises on the functional status of veterans, analyzing the dynamics of specific psychophysiological indicators, and developing differentiated physical and sports rehabilitation programs based on the nature of combat injuries and the level of functional limitations.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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